MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC JEE MAINS | **UNIT – III** | **Date: 26-04-2020**
Time: | **ASSIGNMENT – 1** | **Max. Marks:**

MATHS

Syllabus: ***CO-OORDINATE GEOMETRY:– 1. STRAIGHT LINES , 2. PAIR OF STRAIGHT LINES, 3.CIRCLES, 4.SYSTEM OF CIRCLES, 5. PARABOLA, 6. ELLIPSE, 7. HYPERBOLA***

1. If the line segment joining (2, 3) and (– 1, 2) is divided internally in the ratio 3 : 4 by the line $x + 2y = k$ then k is

(A) $\frac{41}{7}$ (B) $\frac{5}{7}$ (C) $\frac{36}{7}$ (D) $\frac{31}{7}$

2. The points (a, b + c), (b, c + a), (c, a + b) are

(A) Vertices of equilateral triangle (B) Collinear
(C) Concyclic (D) None of these

3. The incentre of the triangle formed by the axes and the line $\frac{x}{a}+\frac{y}{b}=1$ is

(A) $\left(\frac{a}{2},\frac{b}{2}\right)$ (B) $\left(\frac{ab}{a+b+\sqrt{ab}},\frac{ab}{a+b+\sqrt{ab}}\right)$

(C) $\left(\frac{a}{3},\frac{b}{3}\right)$ (D) $\left(\frac{ab}{a+b+\sqrt{a^2+b^2}},\frac{ab}{a+b+\sqrt{a^2+b^2}}\right)$

4. In the ΔABC, the coordinates of B are (0, 0), AB = 2, $\angle ABC=\frac{\pi}{3}$ and the middle point of BC has the coordinates (2, 0). The centroid of the triangle is

(A) $\left(\frac{1}{2},\frac{\sqrt{3}}{2}\right)$ (B) $\left(\frac{5}{3},\frac{1}{\sqrt{3}}\right)$ (C) $\left(\frac{4+\sqrt{3}}{3},\frac{1}{3}\right)$ (D) None of these

5. The area of the pentagon whose vertices are (4, 1), (3, 6), (– 5, 1), (– 3, – 3) and (– 3, 0) taken in order is

(A) 30 unit^2 (B) 60 unit^2 (C) 120 unit^2 (D) None of these

6. A point move in the x-y plane such that the sum of its distances from two mutually perpendicular lines is always equal to 3. The area enclosed by the locus of the point is

(A) 18 unit^2 (B) $\frac{9}{2}$ unit^2 (C) 9 unit^2 (D) None of these

7. The points $(\alpha,\beta),(\gamma,\delta),(\alpha,\delta)$ and (γ,β) taken in order, where $\alpha,\beta,\gamma,\delta$ are different real numbers, are

(A) Collinear (B) Vertices of a square
(C) Vertices of a rhombus (D) Concylic

8. The distance of the line $2x – 3y = 4$ from the point (1, 1) in the direction of the line $x + y = 1$ is

(A) $\sqrt{2}$ (B) $5\sqrt{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) None of these

9. The four sides of a quadrilateral are given by the equation $xy(x-2)(y-3)=0$. The equation of the line parallel to $x-4y=0$ that divides the quadrilateral in two equal areas is
(A) $x-4y+5=0$ (B) $x-4y-5=0$
(C) $4y=x+1$ (D) $4y+1=x$

10. ABC is an isosceles triangle in which A is $(-1, 0)$, $\angle A = 2\pi/3, AB = AC$ and AB is along the x-axis. If BC = $4\sqrt{3}$ then the equation of the line BC is
(A) $x+\sqrt{3}y=3$ (B) $\sqrt{3}x+y=3$ (C) $x+y=\sqrt{3}$ (D) None of these

11. The coordinates of the point on the x-axis which is equidistant from the points $(-3, 4)$ and $(2, 5)$ are
(A) (20, 0) (B) (– 23, 0) (C) $\left(\frac{4}{5}, 0\right)$ (D) None of these

12. The distance between the lines $3x+4y=9$ and $6x+8y+15=0$ is
(A) $\frac{3}{10}$ (B) $\frac{33}{10}$ (C) $\frac{33}{5}$ (D) None of these

13. If a vertex of an equilateral triangle is the origin and the side opposite to it has the equation $x+y=1$ then the orthocenter of the triangle is
(A) $\left(\frac{1}{3}, \frac{1}{3}\right)$ (B) $\left(\frac{\sqrt{2}}{3}, \frac{\sqrt{2}}{3}\right)$ (C) $\left(\frac{2}{3}, \frac{2}{3}\right)$ (D) None of these

14. The equations of the three sides of a triangle are $x=2$, $y+1=0$ and $x+2y=4$. The coordinates of the circumcentre of the triangle are
(A) (4, 0) (B) (2, – 1) (C) (0. 4) (D) None of these

15. L is a variable line such that the algebraic sum of the distance of the points (1, 1), (2, 0) and (0, 2) from the line is equal to zero. The line L will always pass through
(A) (1, 1) (B) (2, 1) (C) (1, 2) (D) None of these

16. If p and p' are the perpendiculars from the origin upon the lines $x\sec\theta + y\operatorname{cosec}\theta = a$ and $x\cos\theta - y\sin\theta = a\cos 2\theta$ respectively then
(A) $4p^2+\left(p'\right)^2=a^2$ (B) $p^2+4\left(p'\right)^2=a^2$ (C) $p^2+\left(p'\right)^2=a^2$ (D) None of these

17. If a, b, c are any three terms of an AP then the line $ax+by+c=0$
(A) Has a fixed direction (B) Always passes through a fixed point
(C) Always cuts intercepts on the axes such that their sum is zero
(D) Forms a triangle with the axes whose area is constant

18. The equations of the sides AB, BC and CA of the ΔABC are $y-x=2$, $x+2y=1$ and $3x+y+5=0$ respectively. The equation of the altitude through B is
(A) $x-3y+1=0$ (B) $x-3y+4=0$ (C) $3x-y+2=0$ (D) None of these

19. Three vertices of a quadrilateral in order are (6, 1), (7, 2) and (– 1, 0). If the area of the quadrilateral is 4 unit^2 then the locus of the fourth vertex has the equation
(A) $x-7y=1$ (B) $x-7y+15=0$
(C) $(x-7y)^2+14(x-7y)-15=0$ (D) None of these

20. Two points A and B move on the x-axis and the y-axis respectively such that the distance between the two points is always the same. The locus of the middle point of AB is
(A) A straight line (B) A pair of straight line
(C) A circle (D) None of these

21. If a ray travelling along the line x = 1 gets reflected from the line x + y = 1 then the equation of the line along which the reflected ray travels is
(A) y = 0 (B) x – y = 1 (C) x = 0 (D) None of these

22. Let P = (1, 1) and Q = (3, 2). The point R on the x-axis such that PR + RQ is the minimum is
(A) $\left(\frac{5}{3},0\right)$ (B) $\left(\frac{1}{3},0\right)$ (C) (3, 0) (D) None of these

23. If the intercept made on the line y = mx by lines y = 2 and y = 6 is less than 5 then the range of values of m is
(A) $\left(-\infty,-\frac{4}{3}\right)\cup\left(\frac{4}{3},+\infty\right)$ (B) $\left(-\frac{4}{3},\frac{4}{3}\right)$ (C) $\left(-\frac{3}{4},\frac{3}{4}\right)$ (D) None of these

24. There are two parallel lines, one of which has the equation 3x + 4y = 2. If the lines cut an intercept of length 5 on the line x + y = 1 then the equation of the other line is
(A) $3x+4y=\frac{\sqrt{6}-2}{2}$ (B) $3x+4y=\frac{\sqrt{6}+2}{2}$ (C) 3x + 4y = 7 (D) None of these

25. The graph of the function cos x . cos (x + 2) – $\cos^2$(x + 1) is a
(A) Straight line passing through the point (0, – $\sin^2$1) with slope 2
(B) Straight line passing through the origin
(C) Parabola with vertex (0, – $\sin^2$1)
(D) Straight line passing through the point $\left(\pi/2,-\sin^2 1\right)$ and parallel to the x-axis

26. If the points (– 2, 0), $\left(-1,1/\sqrt{3}\right)$ and $\left(\cos\theta,\sin\theta\right)$ are collinear then the number of values of $\theta\in[0,2\pi]$ is
(A) 0 (B) 1 (C) 2 (D) Infinitely many

27. The limiting position of the point of intersection of the lines 3x + 4y = 1 and (1 + c)x + $3c^2$y = 2 as c tends to 1 is
(A) (– 5, 4) (B) (5, – 4) (C) (4, – 5) (D) None of these

28. The coordinates of two consecutive vertices A and B of a regular hexagon ABCDEF are (1, 0) and (2, 0) respectively. The equation of the diagonal CE is
(A) $\sqrt{3}x+y=4$ (B) $x+\sqrt{3}y+4=0$ (C) $x+\sqrt{3}y=4$ (D) None of these

29. The coordinates of three consecutive vertices of a parallelogram are (1, 3), (– 1, 2) and (2, 5). The coordinates of the fourth vertex are
(A) (6, 4) (B) (4, 6) (C) (– 2, 0) (D) None of these

30. The equation of a straight line passing through the point (– 2, 3) and making intercepts of equal length on the axes is
(A) 2x + y + 1 = 0 (B) x – y = 5 (C) x – y + 5 = 0 (D) None of these

31. If the two vertices of a triangle are (7, 2) and (1, 6) and its centroid is (4, 6) then the coordinate of the third vertex are (a, b). The value of (a + b), is
(A) 13 (B) 14 (C) 15 (D) 16

32. The orthocenter of the triangle ABC is 'B' and the circumcentre is 'S' (a, b). If A is the origin then the co-ordinates of C are
(A) (2a, 2b) (B) $\left(\frac{a}{2},\frac{b}{2}\right)$ (C) $\left(\sqrt{a^2+b^2},0\right)$ (D) (a, 2b)

33. If P(1, 2), Q(4, 6), R(5, 7) & S(a, b) are the vertices of a parallelogram PQRS, then
(A) a = 2, b = 4 (B) a = 3, b = 4 (C) a = 2, b = 3 (D) a = 3, b = 5

34. Let ΔABC have vertices A(– 4, – 3), B(6, – 1) and C(2, 5). Find the length of the median from C to AB?

(A) $\sqrt{50}$ (B) $\sqrt{53}$ (C) $\sqrt{89}$ (D) $\sqrt{104}$

35. Let k be a non-zero real number. The two lines with equations $y - 3x + k = 0$ and $6x - 2y = k$

(A) Coincide (B) Do not coincide but are parallel

(C) Are perpendicular (D) Intersect, but are not perpendicular

36. A line in the xy plane is parallel to the line $2x + 7y = 3$ and passes through the point (3, – 1) y-intercepts of the line, is

(A) $\frac{-3}{7}$ (B) $\frac{-1}{7}$ (C) $\frac{1}{7}$ (D) $\frac{3}{7}$

37. Line L, perpendicular to the line with equation $y = 3x - 5$, contains the point (1, 4). The x-intercepts of L, is

(A) 12 (B) 13 (C) 14 (D) 15

38. If the angle between the lines is $\frac{\pi}{4}$ and slope of one of the lines is $\frac{1}{2}$, then the slope of the other line is

(A) $\frac{7}{2}$ (B) 3 (C) $\frac{2}{7}$ (D) $\frac{1}{3}$

39. One of the vertices of an equilateral triangle is (2, 3) and the equation of its opposite side is $x + y - 2 = 0$. The area of triangle is

(A) $3\sqrt{3}$ (B) $6\sqrt{3}$ (C) $\frac{3\sqrt{3}}{2}$ (D) $\sqrt{6}$

40. The co-ordinates of the orthocentre of the triangle bounded by the lines, $4x - 7y + 10 = 0$; $x + y = 5$ and $7x + 4y = 15$ is a

(A) (2, 1) (B) (– 1, 2) (C) (1, 2) (D) (1, – 2)

41. If the image of the $M(\lambda, \lambda^2)$ in the line $x + y = \lambda^2$ is (0, 2) then λ can be

(A) – 1 (B) – 2 (C) 1 (D) 4

42. A triangle has two of its vertices at (0, 1) and (2, 2) in the Cartesian plane. Its third vertex lies on the x-axis. If the area of the triangle is 2 square units then the sum of the possible abscissae of the third vertex, is

(A) – 4 (B) 0 (C) 5 (D) 6

43. Find the area of the quadrilateral ABCD with vertices A(– 2, 0), B(0, – 4), C(4, – 2) and D(2, 2)

(A) 12 sq. unit (B) 16 sq. unit (C) 20 sq. unit (D) 32 sq. unit

44. If A and B are the points (– 3, 4) and (2, 1), then the coordinates of the point C on AB produced such that AC = 2BC are

(A) (2, 4) (B) (3, 7) (C) (7, – 2) (D) $\left(-\frac{1}{2}, \frac{5}{2}\right)$

45. The perpendicular bisector of the line segment joining A(1, 4) and B(t, 3) has y-intercept – 4. Then a possible value of t is

(A) 1 (B) 2 (C) – 2 (D) – 4

46. The line through point (m, – 9) and (7, m) has slope m. The y-intercept of this line, is

(A) – 18 (B) – 6 (C) 6 (D) 18

47. The line L_1 given by $\frac{x}{5}+\frac{y}{b}=1$ passes through the point M(13, 32). The line L_2 is parallel to L_1 and has the equation $\frac{x}{c}+\frac{y}{3}=1$. Then the distance between L_1 and L_2 is

(A) $\sqrt{17}$ (B) $\frac{17}{\sqrt{15}}$ (C) $\frac{23}{\sqrt{17}}$ (D) $\frac{23}{\sqrt{15}}$

48. The orthocentre of the triangle formed by the lines xy = 0 and x + y = 1 is

(A) $\left(\frac{1}{2},\frac{1}{2}\right)$ (B) $\left(\frac{1}{3},\frac{1}{3}\right)$ (C) (0, 0) (D) $\left(\frac{1}{4},\frac{1}{4}\right)$

49. The points (– 2, – 5), (2, – 2), (8, a) are collinear, then the value of a is

(A) $-\frac{5}{2}$ (B) $\frac{5}{2}$ (C) $\frac{3}{2}$ (D) $\frac{1}{2}$

50. If the segment joining the points (a, b) and (c, d) subtends a right angle, at the origin, then

(A) ac – bd = 0 (B) ac + bd = 0 (C) ab + cd = 0 (D) ab – cd = 0

51. The equation of the straight line which is perpendicular to y = x and passes through (3, 2) is

(A) x – y = 5 (B) x + y = 5 (C) x + y = 1 (D) x – y = 1

52. The inclination of the straight line passing through the point (– 3, 6) and the mid point of the line joining the points (4, – 5) and (– 2, 9) is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{3}$ (D) $\frac{3\pi}{4}$

53. Three points (0, 0), $\left(3,\sqrt{3}\right)$, $(3,\lambda)$ form an equilateral triangle. Then λ =

(A) 2 (B) – 3 (C) – 4 (D) $-\sqrt{3}$

54. The point (– 4, 5) is the vertex of a square and one of its diagonals is 7x – y + 8 = 0. The equation of the other diagonal is

(A) 7x – y + 23 = 0 (B) x + 7y = 31 (C) x – 7y = 37 (D) None of these

55. Two points (a, 0) and (0, b) are joined by a straight line. Another point on this line is

(A) (3a, – 2b) (B) (a^2, ab) (C) (– 3a, 2b) (D) (a, b)

56. The equation of the line through (1, 1) and making an angle of 45° with the line x + y = 0 are

(A) x – 1 = 0, x – y = 0 (B) x – y = 0, y – 1 = 0
(C) x + y – 2 = 0, y – 1 = 0 (D) x – 1 = 0, y – 1 = 0

57. The distance between the lines 3x + 4y = 9 and 6x + 8y = 15 is

(A) $\frac{6}{5}$ (B) $\frac{3}{10}$ (C) $\frac{3}{12}$ (D) 6

58. The number of lines that are parallel to 2x + 6y – 7 = 0 and have an intercept 10 between the co-ordinate axis is

(A) 1 (B) 2 (C) 4 (D) Infinitely many

59. The straight line $x + y + 1 + \lambda(2x - y - 1) = 0$ is $\perp$ to 2x + 3y – 8 = 0, then λ is equal to

(A) 5 (B) – 5 (C) 4 (D) – 4

60. The point moves such that the area of the triangle formed by it with the points (1, 5) and (3, – 7) is 21 sq. unit. The locus of the point is

(A) 6x + y – 32 = 0 (B) 6x – y + 32 = 0 (C) x + 6y – 32 = 0 (D) 6x – y – 32 = 0

61. The algebraic sum of the perpendicular distances from the vertices of a triangle to a variable line is 'O', then the line passes through the ___ of the triangle

(A) Incentre (B) Centroid (C) Orthocentre (D) Circumcentre

62. The equation of the sides of a triangle are $x - 3y = 0$, $4x + 3y = 5$, $3x + y = 0$. The line $3x - 4y = 0$ passes through

(A) Incentre (B) Centroid (C) Orthocentre (D) Circumcentre

63. Suppose A, B are two points on $2x - y + 3 = 0$ and P(1, 2) is such that PA = PB. Then the mid point of AB is

(A) $\left(\frac{-1}{5},\frac{13}{5}\right)$ (B) $\left(\frac{-7}{5},\frac{9}{5}\right)$ (C) $\left(\frac{7}{5},\frac{-9}{5}\right)$ (D) $\left(\frac{-7}{5},\frac{-9}{5}\right)$

64. A line passing through the points (7, 2), (– 3, 2) then the image of the line in x-axis is

(A) $y = 4$ (B) $y = 9$ (C) $y = -1$ (D) $y = -2$

65. If one vertex of an equilateral triangle is the origin and side opposite to it has the equation $x + y = 1$, then the orthocentre of the triangle is

(A) $\left(\frac{1}{3},\frac{1}{3}\right)$ (B) $\left(\frac{2}{3},\frac{2}{3}\right)$ (C) (1, 1) (D) (1, 3)

66. The point on the line $3x - 2y = 1$ which is closest to the origin is

(A) $\left(\frac{3}{13},\frac{2}{13}\right)$ (B) $\left(\frac{5}{11},\frac{2}{11}\right)$ (C) $\left(\frac{3}{5},\frac{2}{5}\right)$ (D) $\left(\frac{3}{13},\frac{-2}{13}\right)$

67. The points (– 1, 1) and (1, – 1) are symmetrical about the line

(A) $y + x = 0$ (B) $y = x$ (C) $x + y = 1$ (D) $x - y = 1$

68. Centroid of the triangle, formed by the lines $x + 2y - 5 = 0$, $2x + y - 7 = 0$, $x - y + 1 = 0$ is

(A) (1, 3) (B) (3, 5) (C) (2, 2) (D) (1, 1)

69. A ray of light along $x+\sqrt{3}y=\sqrt{3}$ gets reflected upon reaching x-axis, the equation of the reflected ray is

(A) $y=x+\sqrt{3}$ (B) $\sqrt{3}y=x-\sqrt{3}$ (C) $y=3x-\sqrt{3}$ (D) $\sqrt{3}y=x-1$

70. Consider the points A(0, 1) and B(2, 0) and P be a point on the line $4x + 3y + 9 = 0$. Coordinates of P such that $|PA-PB|$ is maximum are

(A) $\left(\frac{-24}{5},\frac{17}{5}\right)$ (B) $\left(\frac{-84}{5},\frac{13}{5}\right)$ (C) $\left(\frac{-6}{5},\frac{17}{5}\right)$ (D) (0, – 3)

71. Let P = (– 1, 0), Q = (0, 0) and R = $\left(3,3\sqrt{3}\right)$ be three points. Then the equation of the bisector of angle PQR is

(A) $\frac{\sqrt{3}}{2}x+y=0$ (B) $2x+\sqrt{3}y=0$ (C) $\sqrt{3}x+y=0$ (D) $x+\frac{\sqrt{3}}{2}y=0$

72. If PS is the median of the triangle with vertices P (2, 2), Q (6, – 1) and R(7, 3) then the equation of the line passing through (1, – 1) and parallel to $\overline{PS}$

(A) $4x - 7y - 11 = 0$ (B) $2x + 9y + 7 = 0$ (C) $x + 7y + 3 = 0$ (D) $2x - 9y - 11 = 0$

73. Consider the family of lines $(x+y-1)+\lambda(2x+3y-5)=0$ and $(3x+2y-4)+\mu(x+2y-6)=0$, equation of a straight line that belongs to both families is

(A) $x - 2y - 8 = 0$ (B) $x - 2y + 8 = 0$ (C) $2x + y - 8 = 0$ (D) $2x - y - 8 = 0$

74. If a ,b and c are three consecutive odd integers then the variable line $ax + by + c = 0$ always passes through

(A) (2, 1) (B) (1, 2) (C) (– 1, 2) (D) (1, – 2)

75. The sides of a triangle are x + y = 1, 7y = x and $\sqrt{3}y+x=0$. Then the following is an interior point of the triangle
(A) Circumcentre (B) Centroid (C) Orthocentre (D) Cannot say

76. If a variable line drawn through the intersection of the lines $\frac{x}{3}+\frac{y}{4}=1$ and $\frac{x}{4}+\frac{y}{3}=1$, meets the coordinate axes at A and B, $(A\neq B)$, then the locus of the midpoint of AB is
(A) 6xy = 7 (x + y) (B) $4(x+y)^2-28(x+y)+49=0$
(C) 7xy = 6 (x + y) (D) $14(x+y)^2-97(x+y)+168=0$

77. A point P moves on the line 2x – 3y + 4 = 0. If Q(1, 4) and R(3, – 2) are fixed points, then the locus of the centroid of triangle PQR is a line
(A) Parallel to y-axis (B) With slope 2/3 (C) Parallel to x-axis (D) With slope 3/2

78. The foot of the perpendicular drawn from the origin, on the line, 3x + y = $\lambda(\lambda\neq0)$ is P. If the line meets x-axis at A and y-axis at B, then the ratio BP : PA is:
(A) 1 : 3 (B) 3 : 1 (C) 1 : 9 (D) 9 : 1

79. If a straight line passing through the point P (– 3, 4) is such that its intercepted portion between the coordinates axes is bisected at P, then its equation is
(A) x – y + 7 = 0 (B) 4x – 3y + 24 = 0 (C) 4x + 3y = 0 (D) 3x – 4y + 25 = 0

80. The point P (2, 1) is translated parallel to the line L: x – y = 4 by $2\sqrt{3}$ units. If the new point Q lies in the third quadrant, then the equation of the line passing through Q and perpendicular to L is
(A) $x+y=2-\sqrt{6}$ (B) $x+y=3-3\sqrt{6}$ (D) $x+y=3-2\sqrt{6}$ (D) $2x+2y=1-\sqrt{6}$

81. L_1 and L_2 are two intersecting lines and the angle between the image L_1 w.r.t. L_2 and that of L_2 w.r.t. L_1 is 45°. Then the angle between L_1 and L_2 is
(A) 20° (B) 15° (C) 45° (D) 60°

82. If the base of an isosceles triangle is of length 2p and the length of the altitude dropped to the base is q, then the distance from the mid point of the base to the side of the triangle is
(A) $\frac{pq}{\sqrt{p^2+q^2}}$ (B) $\frac{2pq}{\sqrt{p^2+q^2}}$ (C) $\frac{3pq}{\sqrt{p^2+q^2}}$ (D) $\frac{4pq}{\sqrt{p^2+q^2}}$

83. The area of the triangle formed by the coordinate axes and the line ax + by = 2ab is
(A) 3ab (B) 4ab (C) 2ab (D) ab

84. A line is drawn through the point (– 4, 5) such that the distance of the point (– 3, 2) from the line is d then maximum value of d
(A) 0 (B) $\sqrt{10}$ (C) $\sqrt{\frac{5}{2}}$ (D) $\sqrt{5}$

85. The four sides of a quadrilateral are given by xy(x-2) (y-3) = 0. The equation of the line parallel to x – 4y = 0 that divides the quadrilateral into two equal areas is
(A) x – 4y + 7 = 0 (B) x – 4y + 5 = 0 (C) x – 4y + 11 = 0 (D) x – 4y + 3 = 0

86. If the origin be shifted to point (3, – 1), then the new equation of line 2x – 3y + 5 = 0 is
(A) 3x + 2y – 14 = 0 (B) 2x – 3y + 14 = 0 (C) 3x – 3y + 14 = 0 (D) 2x – 3y – 14 = 0

87. If L: $x+y=\frac{1}{2}$ intersects $x^2+y^2=1$ at 2 points A & B. Then joint equation of line passing through origin & points A and B is
(A) $3x^2+3y^2+8xy=0$ (B) $8x^2+8y^2=3xy$ (C) $3x^2+8y^2=xy$ (D) $x^2+y^2=5xy$

88. Let O(0, 0), P(3, 4), Q(6, 0) be the vertices of the triangle OPQ. The point R inside the triangle OPQ is such that the triangles OPR, PQR, OQR are of equal area. The coordinates of R are

(A) $\left(\frac{4}{3},3\right)$ (B) $\left(3,\frac{2}{3}\right)$ (C) $\left(3,\frac{4}{3}\right)$ (D) $\left(\frac{4}{3},\frac{2}{3}\right)$

89. The combined equation of the lines passing through the origin and having slopes 3 and – 2 is

(A) $6x^2-xy+y^2=0$ (B) $x^2+xy-6y^2=0$ (C) $6x^2+xy-y^2=0$ (D) $x^2-xy+6y^2=0$

90. If the sum of the slopes of the lines given by $x^2-2cxy-7y^2=0$ is four times their product, then c has the value

(A) 2 (B) – 1 (C) 1 (D) – 2

91. If a, b and c are three consecutive odd integers then the variable line ax + by + c = 0 always passes through

(A) (2, 1) (B) (1, 2) (C) (– 1, 2) (D) (1, – 2)

92. If the line 2x + y = k passes through the point which divides the line segment joining the points (1, 1) and (2, 4) in the ratio 3 : 2, then k equals

(A) 29/5 (B) 5 (C) 6 (D) 11/5

93. The line mid way between the lines $L_1: 5x-2y-9=0$ & $L_2: 5x-2y+7=0$ intersect the curve, which is locus of point $(\lambda,\lambda+1)$ $(\lambda\in\square)$; at point

(A) (1, 3) (B) (1, 2) (C) (– 1, 3) (D) (– 1, 4)

94. Equation of line through the intersection of lines 2x + 3y = 4 and x – 5y + 7 = 0 which passes through point (– 4, 0) is

(A) 6x – 17y + 24 = 0 (B) 6x – 7y + 24 = 0
(C) 6x +17y + 24 = 0 (D) 6x + 7y + 24 = 0

95. The equation of the line through the point of intersection of the lines x – y + 1 = 0 and 2x – 3y + 5 = 0 and whose distance from the point (3, 2) is $\frac{7}{5}$ is equal to

(A) $3x+4y+6=0, 4x+3y+6=0$ (B) $3x-4y+6=0, 4x-3y+1=0$
(C) $4x+3y+6=0, 3x+4y+6=0$ (D) $4x+3y+6=0, 3x+4y-6=0$

96. In what direction should a line be drawn through the point (1, 2) so that its point of intersection with the line x + y = 4 is at a distance $\frac{\sqrt{6}}{3}$ units from the given point is?

(A) 15°, 75° (B) 30°, 60° (C) $22\frac{1^\circ}{2}$, $67\frac{1^\circ}{2}$ (D) 45°, 75°

97. Equation of the line passing through the point of intersection of lines 5x – 2y – 1 = 0 and x – y + 1 = 0 and the centre of circle $x^2+y^2-6x+4y-36=0$ is

(A) 2x + 3y = 0 (B) y = 2x (C) 3x – 2y – 13 = 0 (D) 2x + y = 4

98. The equation to the image of the pair of lines $ax^2+2hxy+by^2=0$ where $h^2>ab$ with respect to y = 0 is

(A) $bx^2+2hxy+ay^2=0$ (B) $bx^2-2hxy+ay^2=0$
(C) $ax^2-2hxy+by^2=0$ (D) $ax^2+2hxy+by^2=0$

99. The equation $ax^2+2\sqrt{ab}\,xy+by^2=0$ represent a pair of lines which are

(A) Perpendicular (B) Coincident (C) Imaginary (D) Parallel

100. Angle between the pair of lines $2x^2-7xy+3y^2+3x+y-2=0$

(A) $\pi/2$ (B) $\pi/3$ (C) $\pi/4$ (D) $\pi/6$

101. The angle between the pair of straight lines formed by joining the points of intersection of $x^2+y^2=4$ and y = 3x + c to the origin is a right angle. Then c^2 is equal to

(A) 20 (B) 13 (C) 1/5 (D) 5

PHYSICS

Syllabus: ***HEAT, HYDROSTATICS AND UNITS & MEASUREMENTS:– 1. THERMAL PROPERTIES, 2. THERMODYNAMICS, 3. KINETICTHEORY OF GASES, 4. ELASTICITY, HYDROSTATICS AND DYNAMICS (Including surface tension and viscosity) 5. UNITS,MEASUREMENTS AND ERRORS***.

1. The radius of sphere is measured to be $(2.1\pm0.5)\text{cm}$. Calculate its surface area with error limits.

(A) $(55.4\pm26.4)\text{cm}^2$ (B) $(55.4\pm23.4)\text{cm}^2$ (C) $(55.4\pm20.4)\text{cm}^2$ (D) None of these

2. Find the percentage error in specific resistance given by $\rho=\frac{\pi r^2 R}{\ell}$ where r is the radius having value $(0.2\pm0.02)\text{cm}$, R is the resistance of $(60\pm2)\Omega$ and ℓ is the length of $(150\pm0.1)\text{cm}$.

(A) 20.4% (B) 21.4% (C) 22.4% (D) 23.4%

3. A physical quantity ρ is related to four variables α,β,γ and η as follows:

$$\rho=\frac{\alpha^3\beta^2}{\sqrt{\gamma}\eta}$$

The percentage errors of measurements in α,β,γ and η are 1%, 3%, 4% and 2% respectively. Find the percentage error in ρ.

(A) 13% (B) 14% (C) 15% (D) 16%

4. The period of oscillation of a simple pendulum is $T=2\pi\sqrt{\frac{L}{g}}$. Length L is about 10 cm and is known to 1 mm accuracy. The period of oscillation is about 0.5 s. The time of 100 oscillations is measured with wristwatch of 1 s time period. What is accuracy in the determination of g?

(A) 9% (B) 13% (C) 6% (D) 5%

5. The frequency (f) of a stretched string depends upon the tension F (dimensions of force), length *l* of the string and the mass per unit length μ of string. Derive the formula for frequency.

(A) $f=k\sqrt{\frac{F}{\mu}}$ (B) $f=k\sqrt{\frac{F^2}{\mu}}$ (C) $f=k\sqrt{\frac{F}{\mu^2}}$ (D) None of these

6. The equation of a wave is given by $y=a\sin\omega\left(\frac{x}{v}-k\right)$, where ω is angular velocity and v is the linear velocity. The dimensions of k will be:

(A) $[T^2]$ (B) $[T^{-1}]$ (C) [T] (D) [LT]

7. If the energy (E), velocity (v) and force (F) be taken as fundamental quantity, then the dimension of mass will be:

(A) Fv^{-2} (B) Fv^{-1} (C) Ev^{-2} (D) Ev^2

8. The dimensions of a/b in the equation $P=\frac{a-t^2}{bx}$, where P is pressure, x is distance and tis time, are:

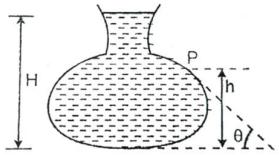
(A) $[M^2LT^{-3}]$ (B) $[MT^{-2}]$ (C) $[LT^{-3}]$ (D) $[ML^3T^{-1}]$

9. Given that $y = A\sin\left[\left(\frac{2\pi}{\lambda}(ct - x)\right)\right]$, where y and x are measured in meters. Which of the following statements is true?
   (A) The unit of λ is same as that of x and A
   (B) The unit of λ is same as that of x but not of A
   (C) The unit of c is same as that of $\frac{2\pi}{\lambda}$
   (D) The unit of 9ct – x) is same as that of $\frac{2\pi}{\lambda}$

10. The physical quantity having the dimensions $\left[M^{-1}L^{-3}T^{3}A^{2}\right]$ is:
   (A) Resistance (B) Resistivity
   (C) Electrical conductivity (D) Electromotive force

11. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constant. The dimensions of a, b and c are respectively:
   (A) $\left[LT^{-2}\right]$,[L] and [T] (B) $\left[L^{2}\right]$,[T] and $\left[LT^{2}\right]$
   (C) $\left[LT^{2}\right]$. [LT] and [L] (D) [L], [LT] and $\left[T^{2}\right]$

12. Figure here shows the vertical cross-section of a vessel filled with a liquid of density ρ. The normal thrust per unit area on the walls of the vessel at point. P, as shown, will be

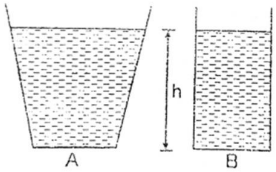


   (A) $h\rho g$ (B) $H\rho g$ (C) $(H-h)\rho g$ (D) $(H-h)\rho g\cos\theta$

13. A tank with length 10 m, breadth 8 m and depth 6m is filled with water to the top. If g = 10 m s^{-2} and density of water is 1000 kg m^{-3}, then the thrust on the bottom is (neglect atmospheric pressure)
   (A) $6\times1000\times10\times80$N (B) $3\times1000\times10\times48$N (C) $3\times1000\times10\times60$N (D) $3\times1000\times10\times80$N

14. In a hydraulic lift, used at a service station the radius of the large and small piston are in the ratio of 20 : 1. What weight placed on the small piston will be sufficient to lift a car of mass 1500 kg?
   (A) 3.75 kg (B) 37.5 kg (C) 7.5 kg (D) 75 kg

15. Two vessels A and B of different shapes have the same base area and are filled with water up to the same height h (see figure). The force exerted by water on the base is F_A for vessel A and F_B for vessel B. The respective weights of the water filled in vessels are WA and WB. Then



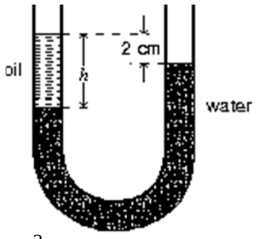
   (A) FA >FB ; WA > WB (B) FA = FB ; WA > WB
   (C) FA = FB ; WA < WB (D) FA > FB ; WA = WB

16. There is a circular tube in a vertical plane. Two liquids which do not mix and of densities d_1 and d_2 are filled in the tube. Each liquid subtends 90° angle at centre. Radius joining their interface makes an angle α with vertical. Ratio d_1 / d_2 is
   (A) $\frac{1+\sin\alpha}{1-\sin\alpha}$ (B) $\frac{1+\cos\alpha}{1-\cos\alpha}$ (C) $\frac{1+\tan\alpha}{1-\tan\alpha}$ (D) $\frac{1+\sin\alpha}{1-\cos\alpha}$

SECTION-II
(Numerical Value Answer Type)

17. During blood transfusion, the bottle of the blood is hanged at a certain height with a stand. If the gauge pressure at a point where the needle is inserted in the vein of a patient is 1500 Pa, find the height of the bottle so that the blood may enter into the vein. Take the density of blood = 1060 kg/m^3.
(A) 15.4 m (B) 10.9 m (C) 12.5 m (D) 14.4 cm

18. The density of water is 1.0 g/cm^3. If h = 20 cm, the density of the oil in the left column of the U-tube shown below is



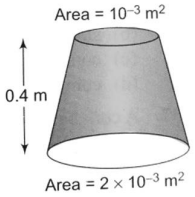
(A) 0.20 g/cm^3 (B) 0.90 g/cm^3 (C) 1.0 g/cm^3 (D) 1.3 g/cm^3

19. Pressure at the bottom of tank of water is 3 P, where P is atmospheric pressure. If the water is drawn out till the level of water is lowered by one-fifth, then the pressure at the bottom of the tank is:
(A) 2P (B) 13P/5 (C) 8P/5 (D) 4P/5

20. A base of rectangular vessel measures 10 cm × 18 cm. water is poured into a depth of 4 cm. What is the pressure on the base of the vessel? What is the thrust on the base of the vessel? Take g = 10 m/s^2.
(A) 6.5 N (B) 3.3 N (C) 7.2 N (D) 5.1 N

21. Three liquids of densities d, 2d and 3d are mixed in equal proportion of weights. If density of water is d, then the specific gravity of the mixture is
(A) 11/7 (B) 18/11 (C) 13/9 (D) 23/18

22. A uniformly tapering vessel is filled with a liquid of density 900 kg/m^3. The force that acts on the base of the vessel due to the liquid is (The vessel is held externally and atmospheric pressure is negligible) (Take, g = 10 m/s^2)



(A) 3.6 N (B) 7.2 N (C) 9.0 N (D) 14.4 N

23. A hydraulic lift has 2 limbs of areas A and 2A. Force F is applied over limb of area A to lift a heavy car. If distance moved by piston P_1 is x, then distance moved by piston P_2 is
(A) x (B) 2x (C) x/2 (D) 4x

24. The approximate depth of an ocean is 2700m. The compressibility of water is $45.4 \times 10^{-11}\ Pa^{-1}$ and density of water is 10^3 kg/m^3. What fractional compression of water will be obtained at the bottom of the ocean?
(A) 0.8×10^{-2} (B) 1.0×10^{-2} (C) 1.2×10^{-2} (D) 1.4×10^{-2}

25. The heart of a man pumps 5L of blood through the arteries per minute at a pressure of 150 mm of $13.6 \times 10^3\ kg/m^3$ and g = 10 m/s^2, then the power of heart in watt is
(A) 1.70 (B) 2.35 (C) 3.0 (D) 1.50

26. Two non-mixing liquids of densities ρ and $n\rho$ $(n>1)$ are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL($p< 1$) in the denser liquid. The density d is equal to

(A) $\{2+(n+1)p\}\rho$ (B) $\{2+(n-1)p\}\rho$ (C) $\{1+(n-1)p\}\rho$ (D) $\{1+(n+1)p\}\rho$

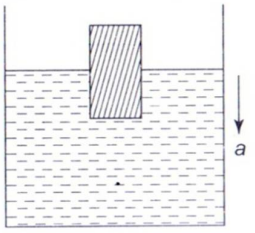
27. An ice cube floats on water in a beaker with 9/10 of its volume submerged under water. What fraction of its volume will be submerged, if the beaker of water is taken to the moon where the gravity is $1/6^{th}$ that on the earth?

(A) 9/10 (B) 27/50 (C) 2/3 (D) Zero

28. A cubical block of steel each side equal to ℓ is floating on mercury in a vessel. The densities of steel and mercury are ρ_s and ρ_m. The height of the block above the mercury level is given by

(A) $\ell\left(1+\frac{\rho_s}{\rho_m}\right)$ (B) $\ell\left(1-\frac{\rho_s}{\rho_m}\right)$ (C) $\ell\left(1+\frac{\rho_m}{\rho_s}\right)$ (D) $\ell\left(1-\frac{\rho_m}{\rho_s}\right)$

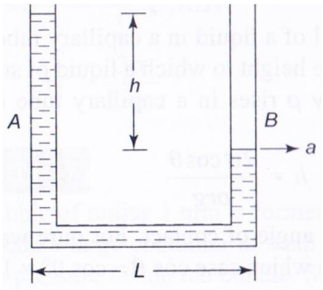
29. A block floats in a liquid contained in a beaker. The beaker is placed on the floor of an elevator. If the levator descends with acceleration a (< g), the upthrust on the block due to the liquid



(A) Is equal to the weight of the liquid displaced
(B) Is greater than the weight of the liquid displaced
(C) Is less than the weight of the liquid displaced
(D) Becomes equal to zero

30. A liquid stands at the same level in arms A and B of a U-tube. If the U-tube is given a constant acceleration a (< g) towards the right as shown in figure. The level of liquid in limb A rises to a height h above the level in limb B.

If the length of the horizontal part of The U-tube is L, the value of h is given by



(A) La/g (B) Lg/a (C) $L\left(1+\frac{a}{g}\right)$ (D) $L\left(1-\frac{a}{g}\right)$

31. Two identical cylindrical vessels, each of base area A, have their bases at the same horizontal level. They contain a liquid of density ρ. In one vessel the height of the liquid is h_1 and in the other $h_2 > h_1$. When the two vessels are connected, the work done by gravity in equalizing the levels is

(A) $2\rho Ag(h_2-h_1)^2$ (B) $\rho Ag(h_2-h_1)^2$ (C) $\frac{1}{2}\rho Ag(h_2-h_1)^2$ (D) $\frac{1}{4}\rho Ag(h_2-h_1)^2$

32. A wooden block of mass m and density ρ is tied to a string; the other end of the string is fixed to the bottom of a tank. The tank is filled with a liquid of density σ with $\sigma > \rho$. What is the tension in the string?

(A) $\left(\frac{\sigma-\rho}{\sigma}\right)mg$ (B) $\left(\frac{\sigma-\rho}{\rho}\right)mg$ (C) $\frac{\rho mg}{\sigma}$ (D) $\frac{\sigma mg}{\rho}$

33. The density of air in earth's atmosphere decreases with height as $\rho = \rho_0 e^{-kh}$, where ρ_0 = density of air at sea level and k is a constant. The atmospheric pressure at sea level is

(A) $\frac{\rho_0 g}{2k}$ (B) $\frac{\rho_0 g}{k}$ (C) $\frac{2\rho_0 g}{k}$ (D) $\frac{\rho_0 g}{\sqrt{2}\,k}$

SECTION-II
(Numerical Value Answer Type)

34. A cube of wood supporting a mass of 200 g just floats in water. When the mass is removed, the cube rises by 2 cm. What is $\ell/5$, where ℓ is side length of cube? (ρ of water is 1000 kg/m^3, g = 10 m/s^2)

(A) 6 (B) 8 (C) 5 (D) 4

35. A vessel contains oil (density 0.8 g/cm^3) over mercury (density 13.6 g/cm^3). A homogeneous sphere floats with half volume immersed in mercury and the other half in oil. The density of the material of the sphere in g/ cm^3 is 0.9 x, find x.

(A) 5 (B) 4 (C) 8 (D) 2

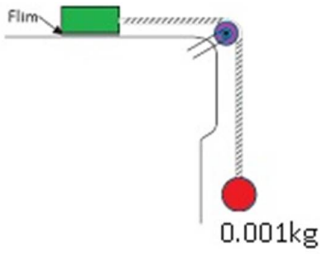
36. The volume of an air bubble is doubled as it rises from the bottom of a lake to its surface. The atmospheric pressure is 75 cm of mercury and the ratio of the density of mercury to that of lake water is 40/3. The depth of the lake is 2h meter, find h.

(A) 5 (B) 4 (C) 9 (D) 1

37. The two thin bones (femurs), each of cross-sectional area 10 cm^2 support the upper part of human body of mass 40 kg. The average pressure sustained by the femurs is $p \times 10^5$ N/m^2, find p.

(A) 2 (B) 3 (C) 4 (D) 6

38. A metal block of area 0.10 m^2 is connected to a 0.001 kg mass via a string that passes over an ideal pulley (considered massless and frictionless), as in figure . A liquid with a film thickness of 0.30 mm is placed between the block and the table. When released the block moves to the right with a constant speed of 0.085 m/s. Find the coefficient of viscosity of the liquid. (height of film = 3mm)



(A) 4×10^{-2} Pa – s (B) 3.45×10^{-3} Pa – s (C) 5×10^{-2} Pa – s (D) 7×10^{-7} Pa – s

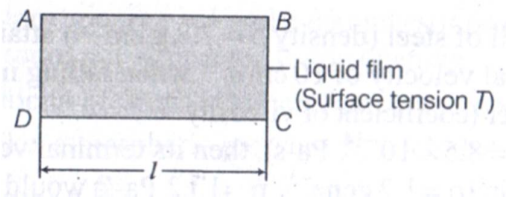
39. Consider two solid spheres P and Q each density 8 g/cm^3 and diameters 1 cm and 0.5 cm, respectively. Sphere P is dropped into a liquid of density 0.8 g/cm^3 and viscosity $\eta = 3$ Poiseuille. Sphere Q is dropped into a liquid of density 1.6 g/cm^3 and visocsity $\eta = 2$ Poiseuille. The ratio of the terminal velocities of P and Q is

(A) 3 : 1 (B) 9 : 1 (C) 2 : 4 (D) 4 : 2

40. The terminal velocity of a copper ball of radius 2.0 mm falling through a tank of oil at 20°C is 6.5 cm/s. Compute the viscosity of the oil at 20°C. Density of oil is 1.5×10^3 kg/m^3, density of copper is 8.9×10^3 kg/m^3.
(A) $1\times10^{-1}\,\text{kgms}^{-1}$ (B) $9.9\times10^{-1}\,\text{kgms}^{-1}$ (C) $24.3\times10^{-2}\,\text{kgms}^{-1}$ (D) $2\times10^{-2}\,\text{kgms}^{-1}$

41. If a ball of steel (density $\rho = 7.8\,\text{g/cm}^3$) attains a terminal velocity of 10 cm/s when falling in tank of water (coefficient of viscosity $\eta_{\text{water}} = 8.5\times10^{-4}\,\text{Pa}-\text{s}$), then its terminal velocity in glycerine $\left(\rho = 1.2\,\text{g/cm}^3, \eta = 13.2\,\text{Pa}-\text{s}\right)$ would be nearly
(A) $1.6\times10^{-5}\,\text{cm/s}$ (B) $6.25\times10^{-4}\,\text{cm/s}$ (C) $6.45\times10^{-4}\,\text{cm/s}$ (D) $1.5\times10^{-5}\,\text{cm/s}$

42. A liquid film is formed over a frame ABCD as shown in figure. Wire CD can slide without friction. Maximum value of mass that can be hanged from CD without breaking the liquid film is



(A) $\frac{T\ell}{g}$ (B) $\frac{2T\ell}{g}$ (C) $\frac{g}{2T\ell}$ (D) $T\times\ell$

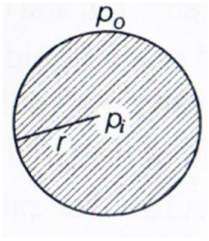
43. A wooden stick 2 m long is floating on the surface of water. The surface tension of water 0.07 N/m. By putting soap solution on one side the sticks, the surface tension is reduced to 0.06 N/m. The net force on the stick will be
(A) 0.07 N (B) 0.06 N (C) 0.01 N (D) 0.02 N

44. The force required to separate two glass plates of 10^{-2} m^2 with a film of water 0.05 mm thick between them, is (surface tension of water is 70×10^{-3} N/m)
(A) 28 N (B) 14 N (C) 50 N (D) 38 N

45. A 10 cm long wire is placed horizontally on the surface of water and is gently pulled up with a force of $2\times10^{-2}\,\text{N}$ to keep the wire in equilibrium. The surface tension in N/m of water is
(A) 0.1 (B) 0.2 (C) 0.001 (D) 0.002

46. The surface tension of water at temperature of the experiment is 7.30×10^{-2} N/m. 1atm pressure = 1.01×10^5 Pa, density of water = 1000 kg/m^3, g = 9.80 m/s^2. Calculate the pressure inside a bubble of radius 1 mm. (about)
(A) 3×10^2 Pa (B) 8×10^4 Pa (C) 1.01×10^5 Pa (D) 7×10^3 Pa

47. In figure, pressure inside a spherical drop is more than pressure outside. (S = surface tension and r = radius of bubble)



The extra surface energy if radius of drop is increased by Δr is
(A) $4\pi r\,\Delta r\,S$ (B) $8\pi r\,\Delta r\,S$ (C) $2\pi r\Delta r\,S$ (D) $10\pi r\Delta r\,S$

48. If the drop is in equilibrium, then energy gain due to pressure difference between the inside and outside the bubble is
(A) $\left(p_i - p_o\right)4\pi r^2\,\Delta r$ (B) $p_o\,4\pi r^2\,\Delta r$ (C) $p_i\,4\pi r^2\,\Delta r$ (D) $\left(p_i + p_o\right)4\pi r^2\,\Delta r$

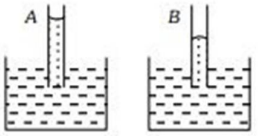
49. A soap bubble of radius r is blown up to form a bubble of radius 2r under isothermal conditions. If σ is the surface tension of soap solution, the energy spent in doing so is

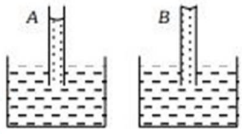
(A) $3\pi\sigma r^2$ (B) $6\pi\sigma r^2$ (D) $12\pi\sigma r^2$ (D) $24\pi\sigma r^2$

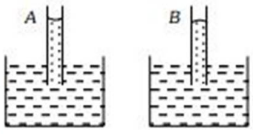
50. The excess pressure inside an air bubble of radius r just below the surface of water is p_1. The excess pressure inside a drop of the same radius just outside the surface is p_2. If T is surface tension, then

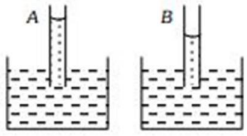
(A) $p_1 = 2p_2$ (B) $p_1 = p_2$ (C) $p_2 = 2p_1$ (D) $p_2 = 0, p_1 \neq 0$

51. A capillary tube A is dipped in water. Another identical tube B is dipped in soap-water solution. Which of the following shows the relative nature of the liquid columns in the two tubes?

(A) 

(B) 

(C) 

(D) 

52. Two capillaries made of same material but of different radii are dipped in a liquid. The rise of liquid in one capillary is 2.2 cm and that in the other is 6.6 cm. The ratio of their radii is

(A) 9 : 1 (B) 1 : 9 (C) 3 : 1 (D) 1 : 3

SECTION-II
(Numerical Value Answer Type)

53. A cube (density 0.5 gm/cc) of side 10 cm is floating in water kept in a cylindrical beaker of base area 1500 cm^2. When a mass m is kept on wooden block the level of water rises in the beaker by 2 mm. Find the mass m (in gm).

(A) 300 (B) 400 (C) 500 (D) 600

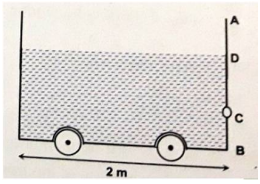
54. An open tank 10 m long and 2 m deep is filled upto 1.5 m height of oil of specific gravity 0.82. The tank is uniformly accelerated along its length from rest to a speed of 20 m/sec horizontally. The shortest time (in sec) in which the speed may be attained without spilling any oil is : [g = 10 m/sec^2]

(A) 30 (B) 20 (C) 50 (D) 10

55. A body floats with (1/3) of its volume outside water when submerged in water and (5/9) of its volume outside another liquid when submerged in another liquid. If density of liquid is $n \times 10^3$ (kg/m^3). Find n.

(A) 2.5 (B) 2.4 (C) 1.5 (D) 1.4

56. A cubical container with side 2 m has a small hole with a cap at point C as shown. The water level is upto point D. (BC = 0.5 m and BD = 1.5 m). If container is given an acceleration of 8 m/s^2 and the hole is opened simultaneously, find the amount of water that will spill out of the container (in litres).



(A) 1200 (B) 1300 (C) 1400 (D) 1600

57. A drop of liquid of radius R = 10^{-2} m having surface tension S = $\frac{0.1}{4\pi}$ N / m divides itself into K identical drops. In this process the total change in the surface energy $\Delta U = 10^{-3}$ J. If K = 10^{α} then the value of α is (approx)

(A) 7 (B) 2 (C) 8 (D) 6

58. Two water pipes of diameters 2 cm and 4 cm are connected along the main supply line in series. The velocity of flow of water in the pipe of 2 cm diameter is

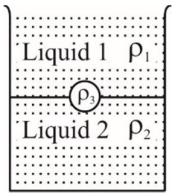
(A) 4 times that in the other pipe (B) $\frac{1}{4}$ times that in the other pipe

(C) 2 times that in the other pipe (D) $\frac{1}{2}$ times that in the other pipe

59. A liquid flows through a pipe of varying diameter. The velocity of the liquid is 2 ms^{-1} at O point where the diamter is 6 cm. The velocity of the liquid at a point where the diameter is 3 cm will be

(A) 1 ms^{-1} (B) 4 ms^{-1} (C) 8 ms^{-1} (D) 16 ms^{-1}

60. A jar is filled with two non-mixing liquids 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball, made of a material of density ρ_3, is dropped in the jar. It comes to equilibrium in the position shown in the figure. Which of the following is true for ρ_1, ρ_2 and ρ_3?



(A) $\rho_3 < \rho_1 < \rho_2$ (B) $\rho_1 < \rho_3 < \rho_2$ (C) $\rho_1 < \rho_2 < \rho_3$ (D) $\rho_1 < \rho_3 < \rho_2$

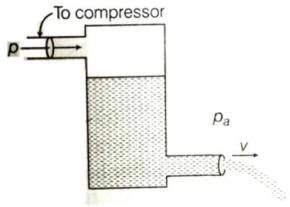
61. The cylindrical tube of a spray pump has radius R, one end of which has n fine holes, each of radius r. if the speed of the liquid in the tube is v, the speed of the ejection of the liquid through the holes is

(A) $\frac{vR^2}{n^2r^2}$ (B) $\frac{vR^2}{nr^2}$ (C) $\frac{vR^2}{n^3r^2}$ (D) $\frac{v^2R}{nr}$

62. Air is streaming past a horizontal airplane's wing such that its speed is 120 ms^{-1} over the upper surface and 90 ms^{-1} at the lower surface. If the density of air is 1.3 kgm^{-3} and the wing is 10 m long and has an average width of 2 m, then the difference of the pressure on the two sides of the wing is

(A) 409.5 Pa (B) 409.50 Pa (C) 40.950 Pa (D) 4.0950 Pa

63. A sealed tank has 2-openings. One at top and other at near bottom. Let height of water filled above the bottom opening is h and compressor producing a pressure p is connected to top opening. Velocity of water obtained from lower opening is (Take, atmospheric pressure P_a such that $P - P_a = \rho gh$



(A) $\sqrt{2gh}$ (B) $\sqrt{gh}$ (C) $2\sqrt{gh}$ (D) 0

64. A cylinder of height 20 m is completely filled with water. The velocity of efflux of water (in ms^{-1}) through a small hole on the side wall of the cylinder near its bottom is [$g = 10\ m/s^2$]
(A) 10 (B) 20 (C) 25.5 (D) 5

65. A hole is made at the bottom of the tank filled with water (density 1000 kgm^{-3}). If the total pressure at the bottom of the tank is 3 atm (1 atm = $10^5\ Nm^{-2}$), then the velocity of efflux is
(A) $\sqrt{200}\ ms^{-1}$ (B) $\sqrt{400}\ ms^{-1}$ (C) $\sqrt{500}\ ms^{-1}$ (D) $\sqrt{800}\ ms^{-1}$

66. The flow of blood in a large artery of an anesthetised dog is diverted through a venturimeter. The wider part of the meter has a cross-sectional area equal to that of the artery, A = 8 mm^2. The narrower part has an area a = 4 mm^2 and density of blood, i.e., $\rho = 1.06 \times 10^3 kgm^{-3}$. The pressure drop in the artery is 24 Pa. What is the speed of the blood in the artery? (in narrow segment).
(A) 0.5 ms^{-1} (B) 0.125 ms^{-1} (C) 1.25 ms^{-1} (D) 2.5 ms^{-1}

67. A fully loaded bowing aircraft has mass of 3.3×10^5 kg. Its total wing area is 500 m^2. It is in level flight with a speed of 960 kmh^{-1}. (i) Estimate the pressure difference between the lower and upper surfaces of the wings (ii) Estimate the fractional increase in the speed of the air on the upper surface of the wing relative to the lower surface. The density of air is $\rho = 1.2\ kgm^{-3}$.
(A) $6.5 \times 10^{+3}\ Nm^{-2}$, 0.01 (B) $6.5 \times 10^3\ Nm^{-2}$, 0.04
(C) $6.5 \times 10^3\ Nm^{-2}$, 0.08 (D) $2.5 \times 10^3\ Nm^{-2}$, 0.02

68. In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70 ms^{-1} and 63 ms^{-1}, respectively. What is the lift on the wing, if its area is 2.5 m^2? (Take the density of air to be 1.3 kgm^{-3})
(A) 2×10^3 N (B) 4×10^2 N (C) 1.51×10^3 N (D) 6×10^3 N

69. The cylindrical tube of a spray pump has a cross-section of 8.0 cm^2 one end of which has 40 fine holes each of diameter 1.0 mm. if the liquid flow inside the tube is 1.5 m/min, what is the speed of ejection of the liquid through the holes?
(A) 0.94 ms^{-1} (B) 0.64 ms^{-1} (C) 0.25 ms^{-1} (D) 0.50 ms^{-1}

70. A U-shaped wire is dipped in a soap solution and removed. The thin soap film formed between the wire and a light slider supports a weight of 1.5×10^{-2} N (which includes the small weight of the slider). The length of the slider is 30 cm. What is the surface tension of the film?
(A) $2.5 \times 10^{-2}\ Nm^{-1}$ (B) $5 \times 10^{-3}\ Nm^{-1}$ (C) $6 \times 10^{-4}\ Nm^{-1}$ (D) $9 \times 10^{-2}\ Nm^{-1}$

71. Steel is preferred over copper in preparing the springs because
A) Steel is cheaper B) Steel does not read with atmosphere
C) Elasticity of steel is more D) Steel also has magnetic property

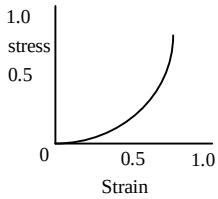
72. Breaking stress of similar wires made up of different materials depends on
A) Area of cross section B) Length of the wire
C) Young's modulus of material of wire D) Density of the wire

73. Bulk modulus Poisson's Ratio perfectly rigid body is cin $\left(N/m^2\right)$
A) infinity, + 0.5 B) 0, 0 C) 1, -0.5 D) 0.5, 0

74. The longitudinal extension of a material is very small to have an appreciable change in length the elastic material must be in the form of
A) short and thin wire B) Thick block with any cross section
C) a long thin wire D) Breaking stress must be very small

75. Four wires A, B, C and D have lengths in the ratio 1 : 2: 4: 6 and their diameters are in the ratio of 1 : 2: 4: 6 respectively. IF the wires are made up of same material and if equal stretching force is applied on the wires which wire will have more elongation for the said force
A) All wires expand equally B) Wire A will expand more
C) Wire D will expand wire D) Wire C will expand more

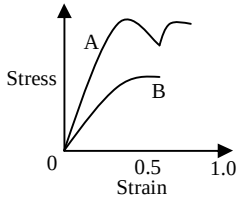
76. Stress – Strain curve for the elastic tissue of Aorta is shown as follow which one of the following true



A) The elastic region is very large B) Does not obey Hooke's law over most of the region
C) It is an elastomer D) All the above

77. Bulk modulus of solids is greater than liquids and which are greater than gases. Which are more compressible
A) Liquids B) Gases C) Solids D) none

78. The diagram shows stress versus strain curve for the materials A and B from the curve we infer that



A) A is brittle but B is ductile B) A is ductile and B is brittle
C) Both A and B are brittle D) Both A and B are ductile

79. A body subjected to strain several times will not obey Hook's law due to
A) Yield point B) Permanent state
C) Elastic fatigue D) Breaking stress

80. A : Ductile metals are used to prepare thin wires.
R : In the stress- strain curve of ductile metals, the length between the points representing elastic limit and breaking point is very small.
A) Both A and R are true and R is the correct explanation of (A)
B) Both A and R are true but R is not a correct explanation of (A)
C) A is true, R is false D) A is false, R is true

81. When a wire is stretched by a force
a) Change in its volume is zero if $\sigma = 0.5$ b) Change in its volume is positive if $\sigma < 0.5$
c) Change in its volume is negative if $\sigma < 0.5$
d) Change of volume does not depend on σ
A) a, b, c, d are correct B) a, b are correct
C) a, b, d are correct D) only d is correct

82. What force is required to stretch a steel wire, $1cm^2$. In cross section to increase its length by 1% $\left[Y = 2 \times 10^{11} N/m^2 \right]$
A) $2 \times 10^5 N$ B) $2 \times 10^7 N$ C) $2 \times 10^{11} N$ D) $4 \times 10^{11} N$

83. A steel wire of length 20 cm and uniform cross section $1mm^2$ is tied rigidly at both the ends. The temperature of the wire is altered from $40^0 C to 20^0 C$. Coefficient of linear expansion for steel $\alpha = 1.1 \times 10^{-5} /^0 C$ and Y for steel is $2 \times 10^{11} N/m^2$. The change in tension of the wire is
A) $2.2 \times 10^6 N$ B) 16 N C) 8 N D) 44 N

84. A load of 1 kg weight is attached to one end of a steel wire of area of cross – section $3mm^2$ and young's modulus $10^{11} N/m^2$. The other end is suspended vertically from a book on a wall, then load is pulled horizontally and released. When the load passes through its lowest position the fractional change in length is $\left(g = 10\ m/s^2 \right)$
A) 10^{-4} B) 10^{-3} C) 10^3 D) 10^4

85. When a metal sphere is suspended at the end of a metal wire its extension is 2.7 mm. If another metal sphere of same material with its radius one third that of previous is suspended then
A) 0.1 mm B) 24.3 mm C) 5.4 mm D) 1.35 mm

86. The length of a metal wire is l_1 when the tension in it is T_1 and is l_2 when the tension is T_2. Then the actual length of the wire is
A) $\frac{l_1T_1 - l_2T_2}{T_1 + T_2}$ B) $\frac{l_1T_2 - l_2T_1}{T_1 + T_2}$ C) $\frac{l_1T_2 + l_2T_1}{T_1 + T_2}$ D) $\frac{l_1T_2 - l_2T_1}{T_1 - T_2}$

87. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied
A) Length = 50 cm, diameter = 0.5 mm B) length = 100 cm, diameter = 1 mm
C) Length = 200 cm, diameter = 2 mm D) length = 300 cm, diameter = 3mm

88. Two wires made of the same material have lengths 3 m and 4 m and weight 18 gm and 16 gm respectively. When they are subjected to the same tension, what is the ratio fo their elongations
A) 1 : 2 B) 2 : 1 C) 3 : 4 D) 4 : 3

89. A steel wire is suspended vertically from a rigid support when loaded with a weight in air, it extends by l_a and when the weight is immersed completely in water, the extension is reduced to l_w. Then the relative density of the material of the weight is
A) $\frac{l_a}{l_w}$ B) $\frac{l_a}{l_a - l_w}$ C) $\frac{l_w}{l_a - l_w}$ D) $\frac{l_w}{l_a}$

90. A thick copper rope of density $1.5\times10^3 Kg/m^3$ and young's modulus $5\times10^8 N/m^2$ is 8 m in length. When hung from the ceiling of a room, the increase in its length due to its own weight is $\left(g = 10ms^{-2}\right)$
A) $9.6\times10^{-4}m$ B) $19.2\times10^{-7}m$ C) $9.6\times10^{-3}m$ D) 9.6 m

91. Two bars A and B of circular cross section and of same volume made of same material are subjected to tension. If the diameter of A is half that of B and if the force applied to both the rods is the same and it is in the elastic limit. The ratio of extension of A to that of B will be
A) 16 B) 8 C) 4 D) 2

92. A cube of side 10 cm is subjected to a tangential force of $5\times10^5 N$ at the upper face, keeping lower face fixed and the upper face is displaced by 0.001 rad relative to lower face along the direction of tangential force. Then shear modulus of the material of the cube is
A) $5\times10^6 N/m^2$ B) $5\times10^8 N/m^2$ C) $5\times10^9 N/m^2$ D) $5\times10^{11} N/m^2$

93. A 1 m long wire of radius 1 mm is clamped to a rigid support. The lower end is twisted through an angle of 45^0. The angle of shear is
A) 0.045^0 B) 0.45^0 C) 4.5^0 D) 45^0

94. The mean density of sea water is 'ρ' and bulk modulus is 'B'. The change in density of sea water in going from the surface of water to a depth of 'h' is
A) $\frac{B\rho^2}{gh}$ B) $B\rho gh$ C) $\frac{\rho^2 gh}{B}$ D) $\frac{\rho gh}{B}$

95. A uniform pressure P is exerted on all sides of a solid cube at temperature 0^0C. In order to bring the volume of the cube to the original volume, the temperature of the cube must be increased by t^0C.. If the linear coefficient and K the bulk modulus of the material of the cube, then t^0C =
A) $\frac{3p}{k\alpha}$ B) $\frac{p}{2k\alpha}$ C) $\frac{p}{3k\alpha}$ D) $\frac{p}{k\alpha}$

96. For a material poisson's ratio is 0.25. Under an external stress, longitudinal strain produced is 1/100. Then the percentage change in the radius of the wire is
A) + 0.5% B) -0.5% C) + 0.25% D) – 0.25%

97. A Material has poisons ratio 0.2. If a uniform rod of it suffers longitudinal strain 4×10^{-3}, the percentage change in volume

A) 0.12 % B) 0.2% C) 0.24% D) 0.3%

98. A wire is made of a material of density $10g/cm^3$ and breaking stress $5\times10^9 N/m^2$. What length of the wire will break under its own weight when suspended vertically $\left(g=10m/s^2\right)$

A) $5\times10^4 m$ B) $10\times10^4 m$ C) $6\times10^4 m$ D) $8\times10^4 m$

99. A body of mass m = 10 kg is attached to a wire of length 0.3m. If its breaking stress is $4.8\times10^7 N/m^2$. The area of cross section of the wire is $10^{-6}m^2$. What is the maximum angular velocity with which it can be rotated in the horizontal circle?

A) 4 rad/sec B) 8 rad/sec C) 1 rad/sec D) 2 rad/sec

100. One end of a uniform wire of length 1 and 1 weight w is attached rigidly to a point in the roof and weight 4 w is suspended from the lower end. If A is the area of cross section of the wire, the stress in the wire at a distance l/4 from its upper end is

A) $\frac{4w}{A}$ B) $\frac{19w}{4A}$ C) $\frac{17w}{4A}$ D) $\frac{14w}{7A}$

101. A wire of length 1 m fixed at one end has a sphere attached to it at the other end. The sphere is projected horizontally with a velocity $\sqrt{9}g$. When it describes a vertical circle, the elongation of the wire at the top and bottom of the circle are in the ratio .

A) 4 : 3 B) 2 : 5 C) 4 : 5 D) 2 : 3

102. The work done in stretching a wire by 0.1 mm is 4 J. The work done in stretching another wire of same material, but with double the radius and half the length by 0.1 mm in joules is

A) 16 B) 32 C) 64 D) 128

103. A uniform rod of $2mm^2$ cross section is heated from $0^0 C to 20^0 C$. IT is prevented from expanding. Energy stored per unit volume is $\left(\alpha=12\times10^{-6}\left({}^0C\right)^{-1}\ \&\ Y=10^{11}N/m^2\right)$

A) $1240\ J/m^3$ B) $1440\ J/m^3$ C) $2880\ J/m^3$ D) $2480\ J/m^3$

104. A wire which obeys Hooke's law is of length l_1 when it is equilibrium under a tension F_1. Its length becomes l_2 when the tension is increased to F_2. The energy stored in this process is

A) $\frac{1}{4}\left(F_1+F_2\right)\left(l_1-l_2\right)$ B) $\frac{1}{2}\left(F_1+F_2\right)\left(l_2-l_1\right)$

C) $\frac{1}{2}\left(F_2-F_1\right)\left(l_2-l_1\right)$ D) $\frac{1}{4}\left(F_2-F_1\right)\left(l_2-l_1\right)$

105. Two wires of same material (Young's modulus 'Y') and same length L but radii R and 2R respectively are joined end to end and a weight 'W' is suspended to the lower end of the combination. The elastic potential energy in the system is

A) $\frac{3W^2L}{4\pi R^2Y}$ B) $\frac{3W^2L}{8\pi R^2Y}$ C) $\frac{5W^2L}{8\pi R^2Y}$ D) $\frac{W^2L}{\pi R^2Y}$

106. The length of a rubber cord is l_1 when the work done on it is 4 J and l_2 when he work done on it is 9 J. The length of the cord, when work done is 16 J is

A) $5l_1-4l_2$ B) $5l_2-4l_1$ C) $9l_1-8l_2$ D) $2l_2-l_1$

107. The rubber cord of a catapult has a cross-sectional area $1mm^2$ and a total unstretched length 10 cm. It is stretched to 12 cm and then released to project a missile of mass 5 g then the velocity of projection of mass is $\left(Y=5\times10^8 N/m^2\right)$

A) 10 m/s B) 20 m/s C) 5 m/s D) 8 m/s

108. A spring of young's modulus 2×10^{11}pa is suspended vertically and subjected to a load of 5 kg and elongation is 2 mm. When the load is doubled – match the following $\left(g=9.8\,m/s^2\right)$

Section – A	Section – B
a) Elongating force	e) 4mm
b) Stress	f) un changed
c) Elongation	g) 98 N
d) Young's modulus	h) doubled

A) a-h, b-g, c-f, d-e B) a-g, b-h, c-e, d-f
C) a-e, b-f, c-g, d-h D) a-f, b-e, c-g, d-h

109. A steel wire of mass 3.16 kg is stretched to a tensile strain of 1×10^{-3}. What is the elastic deformation energy, if density $\rho=7.9g/cc\ \&\ Y=2\times10^{11}N/m^2$

(A) 4 KJ (B) 0.4 KJ (C) 0.04 KJ (D) 4 J

110. If the shear modulus and bulk modulus of a material are $0.42\times10^{11}Nm^{-2}$ and $0.56\times10^{11}Nm^{-2}$ respectively. Then young's modulus of that material is

(A) $10^{10}Nm^{-2}$ (B) $1.33\times10^{11}Nm^{-2}$ (C) $0.75\times10^{11}Nm^{-2}$ (D) $10^{11}Nm^{-2}$

CHEMISTRY

Syllabus: ***FIRST YEAR PHYSICAL CHEMISTRY:– 1.ATOMIC STRUCTURE, 2. STATES OF MATTER, 3. STOICHIOMETERY, 4. THERMODYNAMICS, 5. CHEMICAL EQUILIBRIUM, 6. IONIC EQUILIBRIUM***

1. The number of waves made by the electron in second Bohr orbit of hydrogen atom is
(A) 2 (B) 3 (C) 4 (D) 8
2. If radius of first Bhor orbit of hydrogen is a_o than de Broglie wavelength of electron in 3rd orbit is
(A) $6\pi a_o$ (B) $\frac{2}{3}\pi a_o$ (C) πa_o (D) $4\pi a_o$
3. For a one-electron atom with nuclear charge Z, the speed vn of the electron in same n-th stationary orbit satisfies
(A) $v_n \propto Z$ (B) $v_n \propto Z^2$ (C) $v_n \propto Z^{-1}$ (D) $v_n \propto Z^{-2}$
4. In hydrogen atom the energy of a certain energy level is $-hcR_\infty/9$. The orbital degeneracy of the level is
(A) 3 (B) 18 (C) 16 (D) 9
5. The nodal surfaces in angular distribution function of all orbital's is
(A) l (B) $n+l$ (C) $n+l-1$ (D) $n-l-1$
6. The time taken by the electron in one complete revolution in nth Bohr's orbit of hydrogen atom is
(A) Inversely proportional to n^2 (B) Directly proportional to $\frac{h}{2\pi}$
(C) Directly proportional to n^3 (D) inversely proportional to $\frac{h}{2\pi}$
7. If uncertainty in position of an electron equals to de-Broglie wavelength, than the percentage uncertainty in velocity equals to
(A) 8% (B) 4% (C) 16% (D) 10%
8. If kinetic energy of a particle related to de-Broglie wavelength of electron as
(A) $\lambda \propto KE$ (B) $\lambda \propto (KE)^2$ (C) $\lambda \propto \frac{1}{KE}$ (D) $\lambda \propto \frac{1}{(KE)^{1/2}}$
9. If the speed of electron in the Bohr's first orbit of hydrogen atom is v, the speed of the electron in the third orbit is
(A) 9v (B) 3v (C) v/3 (D) v/9

10. A microscope using suitable photons is employed to locate an electron in an atom within a distance of $0.1A^0$. The uncertainty in velocity is

(A) $5.79\times10^6 ms^{-1}$ (B) $5.79\times10^8 ms^{-1}$ (C) $5.79\times10^5 ms^{-1}$ (D) $5.79\times10^7 ms^{-1}$

11. If λ_0 is the de Broglie wavelength for a proton accelerated through a potential difference of 100 V, the de Broglie wavelength for α-particle accelerated through the same potential difference is

(A) $2\sqrt{2\lambda_0}$ (B) $\frac{\lambda_0}{2}$ (C) $\frac{\lambda_0}{2\sqrt{2}}$ (4) $\frac{\lambda_0}{\sqrt{2}}$

12. The wavelength of a cricket ball weighing 100 g and travelling with a velocity of 50 m/s is

(A) 1.3×10^{-28} m (B) 1.3×10^{-37} m (C) 1.3×10^{-34} m (D) 1.3×10^{-30} m

13. The ratio of difference of energy of first and second orbit of hydrogen atom to second and n^{th} Bohr's orbit of He^+ ion is 27/20. The value of n is

(A) 4 (B) 3 (C) 5 (D) 6

14. The total spin resulting from a d^7 configuration is

(A) 1 (B) 2 (C) 5/2 (D) 3/2

15. The normalized wave function for electron in hydrogen atom is given below:

$$\psi_{1,0,0} = \frac{1}{\sqrt{\pi}}\left(\frac{Z}{a_0}\right)^{3/2} e^{-Zr/a_0}$$

Find out the relation between r (most probable distance from nucleus) and a_0 (Bohr's radius).

(A) $a_0 = r_0$ (B) $a_0 = 0.5\ r_0$ (C) $a_0 = 1.5\ r_0$ (D) $a_0 = 2r_0$

16. For an electron whose *x*-positional uncertainty is 5.0×10^{-11} m, the uncertainty in the *x*-component of the velocity in ms^{-1} will be of the order of
(Data: $m_e = 9 \times 10^{-31}$ kg, $h = 6.6 \times 10^{-34}$ Js)

(A) 10^6 (B) 10^9 (C) 10^{12} (D) 10^7

17. An electron is found in an orbital with one radial node and two angular nodes. Which orbital the electron is in?

(A) 1s (B) 2p (C) 3d (D) 4d

18. Which of the following is physical canonical conjugate of uncertainty of energy?

(1) Uncertainty in position (2) Uncertainty in momentum

(3) Uncertainty in time (4) Uncertainty in angular momentum

19. Of the following transitions in hydrogen atom, the one which gives an absorption line of maximum wavelength is

(A) n = 1 to n = 2 (B) n = 3 to n = 8 (C) n = 2 to n = 1 (D) n = 8 to n = 3

20. The wave number of the first line in the Balmer series of hydrogen atom is 15200 cm^{-1}. What is the wave number of first line in the Balmer series of Be^{3+}?

(A) $2.432\times10^5 cm^{-1}$ (B) $15200 cm^{-1}$ (C) $415200 cm^{-1}$ (D) $215200 cm^{-1}$

21. The wavelength associated with a golf ball weighing 200 g and moving at a speed of 5 m/h is of which order

(A) 10^{-10}m (B) 10^{-20}m (C) 10^{-30}m (D) 10^{-40}m

22. The energy of the second Bohr orbit in the hydrogen atom is – 3.41 eV. The energy of the second Bohr orbit oh He^+ ion would be

(A) – 0.85 eV (B) – 13.34 eV (C) – 1.70 eV (D) – 6.82 Ev

23. The second line of Lyman series of H coincides with the sixth line of Paschen series of an ionic species X. Find X assuming R to be same for both H and X?

(A) He^+ (B) Li^{2+} (C) Li^+ (D) H

24. The energy of an electron in the first Bohr orbit of H-atom is – 13.6 eV. The possible energy value of the 3^{rd} excited state for electron in Bohr orbit of hydrogen is

(A) – 3.4 eV (B) – 0.85 eV (C) – 6.8 eV (D) + 6.8 eV

25. An electron in a Bohr orbit of hydrogen atom with the quantum number n_2 has an angular momentum $4.2176\times10^{-34}\,kg\,m^2/s$. If electron drops from this level to the next lower level, find the wavelength of this line.

(A) $18.75\times10^{-7}\,m$ (B) $1.87\times10^{-7}\,m$ (C) $187.5\times10^{-7}\,m$ (D) $0.187\times10^{-7}\,m$

26. Frequency of revolution of e^- in shell

(A) $\frac{2\pi r}{V}$ (B) $\frac{\frac{4}{3}\pi r^3}{V}$ (C) $\frac{V}{2\pi r}$ (D) $\frac{qV}{2\pi r}$

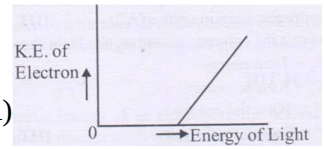
27. A stream of electrons from a heated filaments was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of h/λ (where λ is wavelength associated with electron wave) is given by

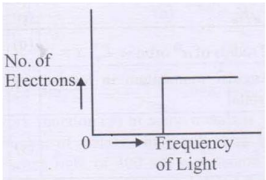
(A) $2meV$ (B) $\sqrt{meV}$ (C) $\sqrt{2meV}$ (D) meV

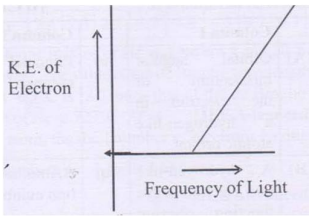
28. The de-Broglie wavelength (λ) associated with a photoelectron varies with the frequency (v) of the incident radiation as, [v_0 is threshold frequency]

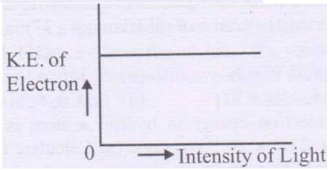
(A) $\lambda\propto\frac{1}{(v-v_0)^{3/2}}$ (B) $\lambda\propto\frac{1}{(v-v_0)}$ (C) $\lambda\propto\frac{1}{(v-v_0)^{1/2}}$ (D) $\lambda\propto\frac{1}{(v-v_0)^{1/4}}$

29. Which of the graphs shown below does not represents the relationship between incident light and the electron ejected from metal surface?

(A) 

(B) 

(C) 

(D) 

30. Which of the following combination of statements is true regarding the interpretation of the atomic orbitals?

(I) An electron in an orbital of high angular momentum stays away from the nucleus than an electron in the orbitals of lower angular momentum

(II) For a given value of principal quantum number, the size of the orbit is inversely proportional to the azimuthal quantum number

(III) According to wave mechanics , the ground state angular momentum is equal to $h/2\pi$

(IV) The plot of E Vs r for various azimuthal quantum numbers, show peak shifting towards higher value.

(A) (II), (III) (B) (I), (III) (C) (I), (IV) (D) (I), (II)

31. What is the work function of metal if the light of wavelength $4000A^0$ generates photoelectrons of velocity $6\times10^5\,m/s$ from it? (Mass of electrons = $9\times10^{-31}\,kg$, velocity of light = $3\times10^8\,m/s$, Planck constant = $6.626\times10^{-34}\,Js$, Charge of electron = $1.6\times10^{-19}\,Je/V$)

(A) 3.1 eV (B) 0.9 eV (C) 4.0 eV (D) 2.1 eV

32. According to Bohr's corresponding principle, the classical mechanics and quantum mechanics give the same result when

(A) The system interacts with the radiation (B) The system is placed in the magnetic field

(C) The system is placed in the electric field (D) The system is in highly excited state

33. How many radial nodes are present in $3d_{xy}$ orbital?

(A) 1 (B) 2 (C) 3 (D) Zero

34. An orbital with *l = 1* and *m=0* is symetrecial about the
(A) x –axis only (B) y – axis only (C) z – axis only (D) xy plane only

35. A sample of sodium has a mass of 46 g. What is the mass of same number of calcium atoms as sodium atoms present in given sample?
(A) 46 g (B) 20 g (C) 40 g (D)80 g

36. Cisplatin, an anticancer drug, has the molecular formula $Pt(NH_3)_2C\ell_2$. What is the mass (in gram) of one molecule? (Atomic masses: Pt = 195, H = 1.0, N = 14, Cl = 35.5)
(A) 4.98×10^{-21} (B) 4.98×10^{-22} (C) 6.55×10^{-21} (D) 3.85×10^{-22}

37. Aspirin has the formula $C_9H_8O_4$. How many atoms of oxygen are there in a tablet weighing 360 mg?
(A) 1.204×10^{23} (B) 1.08×10^{22} (C) 1.204×10^{24} (D) 4.81×10^{21}

38. 3.011×10^{22} atoms of an element weighs 1.15 gm. The atomic mass of the element is
(A) 10 amu (B) 2.3 amu (C) 35.5 amu (D) 23 amu

39. Which of the following contains the largest mass of hydrogen atoms?
(A) 5.0 moles $C_2H_2O_4$ (B) 1.1 moles $C_3H_8O_3$
(C) 1.5 moles $C_6H_8O_6$ (D) 4.0 moles $C_2H_4O_2$

40. Hydrogen and oxygen combine to form H_2O_2 and H_2O containing 5.93% and 11.2% hydrogen respectively. The data illustrates
(A) law of conservation of mass (B) law of constant proportion
(C) law of reciprocal proportion (D) law of multiple proportion

41. If water sample are taken from sea, rivers or lake, they will be found to contain hydrogen and oxygen in the approximate ratio 1 : 8. This indicates the law of:
(A) multiple proportion (B) definite proportion
(C) reciprocal proportions (D) none of these

42. What percentage of oxygen is present in the compound $CaCO_3.3Ca_3(PO_4)_2$?
(A) 23.3% (B) 45.36% (C) 41.94% (D) 17.08%

43. Calculate the molality of 1 L solution of 80% H_2SO_4 (w/V), given that the density of the solution is 1.80 g/mL.
(A) 8.16 (B) 8.6 (C) 1.02 (D) 10.8

44. How many atoms are contained in a mole of acetic acid?
(A) $8\times6.02\times10^{23}$ atom / mol (B) $4\times6.02\times10^{23}$ atom / mol
(C) $6\times6.02\times10^{23}$ atom / mol (D) None of these

45. How many moles of electrons weigh one kilogram?
(A) 6.023×10^{23} (B) $\frac{1}{9.108}\times10^{31}$ (C) $\frac{6.023}{9.108}\times10^{54}$ (D) $\frac{1}{9.108\times6.023}\times10^{8}$

46. An oxide of a metal (M) contains 40% by mass of oxygen. Metal (M) has atomic mass of 24. The empirical formula of the oxide is:
(A) M_2O (B) MO (C) M_2O_3 (D) M_3O_4

47. 8 g of oxygen has same number of atoms in:
(A) 2 g H_2 (B) 8 g O_3 (C) 16 g O_3 (D) 4 g H_2

48. The normality of 0.3 M phosphorus acid (H_3PO_3) is:
(A) 0.1 (B) 0.9 (C) 0.3 (D) 0.6

49. Number of electrons in 1.8 mL of H_2O is
(A) 6.02×10^{23} (B) 3.011×10^{23} (C) 0.06022×10^{23} (D) 60.22×10^{23}

50. The least number of molecules are contained in:
(A) 2 g hydrogen (B) 8 g oxygen (C) 4 g nitrogen (D) 16 g CO_2

51. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The molarity of urea solution is:
(A) 0.1 (B) 0.01 (C) 0.02 (D) 0.001

52. The normality of 0.3 M phosphorus acid (H_3PO_3), phosphoric acid (H_3PO_4) and boric acid (H_3BO_3) are respectively:
(A) 0.9, 0.9, 0.9, (B) 0.6, 0.9, 0.9 (C) 0.6, 0.9, 0.1 (D) 0.9, 0.9, 0.1

53. Mole fraction of solute present in an aqueous solution having molality equal to 2.
(A) 0.9653 (B) 0.347 (C) 0.653 (D) 0.0347

54. Which has maximum number of atoms?
(A) 24 g of C (12) (B) 56 g of Fe (56)
(C) 27 g of Al (27) (D) 108 g of Ag (108)

55. The normality of 10% (weight/volume) acetic acid is:
(A) 1 N (B) 10 N (C) 1.7 N (D) 0.83 N

56. The molality of 15% (w/V) solution of H_2SO_4 of density 1.1 g/cm^3 is approximately:
(A) 1.2 (B) 1.4 (C) 1.8 (D) 1.6

57. An oxide of iodine (I = 127) contains 25.4 g of iodine for 8 g of oxygen. Its formula could be:
(A) I_2O_3 (B) I_2O (C) I_2O_5 (D) I_2O_7

58. The number of Ca atoms in 100 gm of $CaCO_3$ is
(A) NA (B) 2 NA (C) 3 NA (D) 5 NA

59. When potassium permanganate is titrated against ferrous ammonium sulphate in acidic medium, the equivalent weight of potassium permanganate is
(A) $\frac{\text{molecular weight}}{3}$ (B) $\frac{\text{molecular weight}}{5}$ (C) $\frac{\text{molecular weight}}{2}$ (D) $\frac{\text{molecular weight}}{10}$

60. Equivalent weight of FeS_2 in the half reaction, $FeS_2 \longrightarrow Fe_2O_3 + SO_2$ is
(A) M/10 (B) M/11 (C) M/6 (D) M/1

61. The equivalent weight of HCl in the given reaction is
$$K_2Cr_2O_7 + 14HCl + \longrightarrow 2KCl + 2CrCl_3 + 3Cl_2 + H_2O$$
(A) 16.25 (B) 36.5 (C) 73 (D) 85.1

62. Equivalent weight of H_3PO_2 when it disproportionate into PH_3 and H_3PO_3 is:
(A) M (B) M/2 (C) M/4 (D) 3M/4

63. When BrO_3^- ion reacts with Br^- in acid medium, Br_2 is liberated. The equivalent weight of Br_2 in this reaction is:
(A) $\frac{5M}{8}$ (B) $\frac{5M}{3}$ (C) $\frac{3M}{5}$ (D) $\frac{4M}{6}$

64. In the following reaction, $As_2S_3 + H^+ + NO_3^- \longrightarrow NO + H_2O + AsO_4^{3-} + SO_4^{2-}$ the equivalent weight of As_2S_3 is related to its molecular weight by:
(A) M/2 (B) M/4 (C) M/24 (D) M/28

65. Hydrazine reacts with KIO_3 in presence of HCl as $N_2H_4 + IO_3^- + 2H^+ + Cl^- \longrightarrow ICl + N_2 + 3H_2O$.
The equivalent masses of N_2H_4 and KIO_3 respectively are:
(A) 8 and 53.5 (B) 16 and 53.5 (C) 8 and 35.6 (D) 8 and 87

66. 0.45 g of an acid of mol. weight 90 was neutralised by 20 mL of 0.54 N caustic potash (KOH). The basicity of acid is:
(A) 1 (B) 2 (C) 3 (D) 4

67. $KMnO_4$ reacts with oxalic acid according to the equation

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Here, 20 mL of 0.1M $KMnO_4$ is equivalent to:

(A) 120 mL of 0.25 M $H_2C_2O_4$ (B) 150 mL of 0.10 M $H_2C_2O_4$
(C) 25 mL of 0.20 M $H_2C_2O_4$ (D) 50 mL of 0.20 M $H_2C_2O_4$

68. What will be the normality of a solution obtained by mixing 0.45 N and 0.60 N NaOH in the ratio 2 : 1 by volume?
(A) 0.4 N (B) 0.5 N (C) 1.05 N (D) 0.15 N

69. When $K_2Cr_2O_7$ is converted to K_2CrO_4, the change in the oxidation state of chromium is:
(A) 0 (B) 6 (C) 4 (D) 3

70. 1 g mixture of equal number of mole of Li_2CO_3 and other metal carbonate (M_2CO_3) required 21.6 mL of 0.5 N HCl for complete neutralisation reaction. What is the approximate atomic weight of the other metal?
(A) 25 (B) 23 (C) 51 (D) 118

71. 0.1 g of a solution containing Na_2CO_3 and $NaHCO_3$ requires 10 mL of 0.01 N HCl for neutralisation using phenolphthalein as indicator. Wt % of Na_2CO_3 in solution is
(A) 25 (B) 32 (C) 50 (D) None of these

72. Ratio of moles of Fe (II) oxidised by equal volumes of equimolar $KMnO_4$ and $K_2Cr_2O_7$ solutions in acidic medium will be:
(A) 5 : 3 (B) 1 : 1 (C) 1 : 2 (D) 5 : 6

73. The number of moles of oxalate ions oxidized by one mole of MnO_4^- ion is -
(A) 1/5 (B) 2/5 (C) 5/2 (D) 5

74. What weight of nitrate ion (calculated as HNO_3) is needed to convert 5g of iodine into iodic acid according to the reaction -

$$I_2 + HNO_3 \longrightarrow HIO_3 + NO_2 + H_2O$$

(A) 12.4 g (B) 24.8 g (C) 0.248 g (D) 49.6 g

75. What volume of 3 molar HNO_3 is needed to oxidise 8 g of Fe^{2+} to Fe^{3+} ?

$$HNO_3 \longrightarrow NO$$

(A) 8 ml (B) 15 .87ml (C) 32 ml (D) 64 ml

76. How many litres of Cl_2 at S.T.P. will be liberated by the oxidation of NaCl with 10 g $KMnO_4$?
(1)3.54 litres (B) 7.08 litres (C) 1.77 litres (D) None of these

77. What volume (in ml) at STP of SO_2 gas is oxidized by 100 ml of 0.1 (M) $H_2Cr_2O_7$ in acid solution ?
(A) 672 ml (B) 224 ml (C) 448 ml (D) 112 ml

78. 25 ml of a 0.1 (M) solution of a stable cation of transition metal z reacts exactly with 25 ml of 0.04 (M) acidified $KMnO_4$ solution. Which of the following is most likely to represent the change in oxidation state of z correctly ?
(A) $Z^+ \longrightarrow Z^{2+}$ (B) $Z^{2+} \longrightarrow Z^{3+}$ (C) $Z^{3+} \longrightarrow Z^{4+}$ (D) $Z^{2+} \longrightarrow Z^{4+}$

79. 0.45 gm. of acid (mol. wt = 90) was exactly neutralized by 20 ml of 0.5 (M) NaOH.

The basicity of the given acid is
(A) 1 (2) 2 (C) 3 (D) 4

80. What is the equivalent weight of NH_3 in the given reaction?

$$3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$$

(A) 17 (B) $\frac{17}{4}$ (C) $\frac{17}{2}$ (D) $\frac{17}{3}$

81. What is the equivalent weight HNO_3 in the given reaction?

$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$$

(A) $\frac{63}{10}$ (B) $\frac{63}{9}$ (C) $\frac{63}{8} \times 10$ (D) $\frac{63}{4} \times 14$

82. What is the equivalent weight of $C_{12}H_{22}O_{11}$ in the following reaction?

$$C_{12}H_{22}O_{11} + 36\,HNO_3 \longrightarrow 6H_2C_2O_4 + 36NO_2 + 23\,H_2O$$

(A) $\frac{342}{36}$ (B) $\frac{342}{12}$ (C) $\frac{342}{22}$ (D) $\frac{342}{3}$

83. What is the equivalent weight of P in the following reaction?

$$P_4 + NaOH \longrightarrow NaH_2PO_2 + PH_3$$

(A) $\frac{31}{4}$ (B) $\frac{31}{3}$ (C) $\frac{31}{2}$ (D) $31 \times 4/3$

84. Calculate the mass of anhydrous HCl in 10 mL of concentrated HCl (density = 1.2 g/mL) solution having 37% HCl by weight.

(A) 4.44 g (B) 4.44 mg (C) 4.44×10^{-3} mg (D) 0.444 μg

85. 5 Lit of $KMnO_4$ solution contain 0.01 equivalent of $KMnO_4$. 50 ml of the given solution contain, how many moles of $KMnO_4$?

$$KMnO_4 \longrightarrow MnO_2$$

(A) $\frac{10^{-6}}{4}$ (B) $\frac{10^{-4}}{3}$ (C) 3×10^{-5} (D) 10^{-5}

86. 0.05 moles of $NaHCO_3$ will react with how many equivalents of $Mg(OH)_2$?

(A) 0.2 equiv (B) 0.05 equiv (C) 0.02 equiv (D) 0.01 equiv

87. In the reaction,

$$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$$

Equivalent weight of iodine will be equal to

(A) its molecular weight (B) 1/2 of its molecular weight

(C) 1/4 of its molecular weight (D) twice of its molecular weight

88. The equivalent weight of Mohr's salt $FeSO_4.(NH_4)_2SO_4.6H_2O$ in redox change is equals to its

(A) molecular weight/2 (B) atomic weight

(C) molecular weight/3 (D) molecular weight

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